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ALTERATIONS IN MAIZE STARCH UNDER THE ACTION OF IRRADIATION AND TEMPERATURE

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ALTERATIONS IN MAIZE STARCH UNDER THE ACTION OF IRRADIATION AND TEMPERATURE

The action of ionization of irradiational starch causes a rupture of the 1-4 and 1-6 leukocyte bonds and leads to the depolymerization of the molecules and the degradative cleavage of functional grooves [1-4]. It was assumed, [2,5] that in addition to the degradation of the micromolecules that "cross-linking" also takes place.

The study starts from the maize VIR-42 which was dried at temperature of the heat carrier of T = 140° C. (The moisture content of the corn prior to drying was 19% and after drying it was 8%). A standard method was used to determine the germination and energy of sprouting in the irradiated dried corn and in the original corn.

Completely ripe corn containing 13% moisture was irradiated with gamma rays of Co^{60} using a GUB-800 unit and exposure doses of 10^5 and $1.5 \cdot 10^6$R. Then the method described in [6] was used to extract the starch also from the non-irradiated corn.

The ratio of the viscosity was calculated from the mean arithmetic values of the discharge time of a starch solution of different concentration in NaOH and a solution of NaOH using a Pinkevich viscometer with a capillary 0.73 mm in diameter at 20°C. The molecular weight in the degree of polymerization would be determined by the method of terminal groups in accordance with a Gagedorn-Jensen [7] method. The alkali lability was determined by the Schoch and Jensen Method [8]. The Amylose content was determined by the "blue number" method as developed by Smirnova-Ikonnikova [9].

As can be seen from Table 1, for doses of 10^5 and $1.5 \cdot 10^5$ are, the energy of sprouting decreases while at $1.5 \cdot 10^6$, the germination also decreases.

Table 1

Conditions for Treating Fully Ripe Corn	Energy of Sprouting	Germination	Starch Yield	Content of Crude Protein therein	Ratio of Viscosities for Starch Content				Degree of Polymerization	Molecular Weight	Amylose Content	Alkali Lability
	%		Weight Mean %		2	1	0.5	0.25			Weight Mean %	
Without Treatment	97	100	57,7	0,65	54,1	6,1	2,3	1,6	710	115000	14,5	18,0
Irradiation, R 10^5	87	100	56,8	0,65	41,7	4,06	2,2	1,39	544	88000	14,5	18,3
$1{,}5 \cdot 10^6$	85	91	58,0	0,63	4,6	2,19	1,47	1,24	299	48500	14,0	22,9
Drying at 140°C	0	0	42,4	1,64	30,7	5,6	2,1	1,39	132	70000	15,0	16,4

The effect of irradiation on a starch yield and the content of "crude" protein, was not observed. The ratio of the viscosities, and the molecular weight decreased even for a small dose, and the alkali lability increases, and the Amylose content, does not change. Starch from corn dried at 140° C shows an increased content of "crude" protein. It has been possible to reduce it to 1.06%, and in the control to 0.34% after purification of the starch with ethyl alcohol [10].

Then we obtained solutions of starches of 0.1% concentration by dispersing the starch samples for 2 and 24 hours in 1 n NaOH.

These were filtered and then studied on an SF-4A spectrophotometer and the square cell would be the side of the square equal to 10 mm and within wave-length range of 230--610 NM.

The optical density D of the solution of irradiated starch was much lower than that of the control. A decrease in the molecular weight and D, as well as an increase in the alkali lability, indicate that even for small doses of irradiation, ruptures of the intramolecular forms of the starch are possible. The optical density of the solution of starch obtained from dried corn after purification with alcohol decreases. The solutions of unpurified starch from the same corn give a much higher D in comparison with the control. Apparently, during the drying the protein reacts with the starch as the result of which the separation with alcohol is hindered and this affects the change of the absorption spectra. By comparing the letter in the case of the starches and the Amyloses under study, which were obtained from the control and the dried grain in accordance with the Schoch Method [11] (Table 2), it can be assumed that under the action of a high T, a more compact arrangement of the Amylose spirals takes place in the starch grain and this causes a rise in D.

Table 2

1 Длина волны, нм	2 Крахмал в зависимости от обработки								Амилоза	
	3 очищенный		5 неочищенный				3 очищенный		5	
	контроль 4	140°C	контроль	140°C	10^5 р	$1,5 \cdot 10^5$ р	контроль 4	140°C	контроль 4	140°C
	6 диспергирование 24 часа						7 диспергирование 2 часа			
230	0,820	0,700	0,731	0,810	0,685	0,102	0,571	0,520	0,205	0,268
260	0,480	0,355	0,358	0,451	0,362	0,223	0,375	0,370	0,120	0,155
280	0,429	0,355	0,319	0,403	0,328	0,207	0,325	0,316	0,095	0,130
300	0,313	0,286	0,296	0,318	0,275	0,166	0,275	0,250	0,080	0,105
420	0,127	0,108	0,106	0,095	0,092	0,030	0,113	0,036	0,020	0,030
530	0,088	0,076	0,083	0,060	0,063	0,018	0,070	0,008	0,007	0,011
610	0,058	0,062	0,068	0,054	0,047	0,014	0,051	0,004	0,001	0,008

1. Wave Length NM
2. Starch as a Function of the Treatments
3. Purified
4. Control
5. Unpurified
6. Dispersion for 24 hours
7. Dispersion for 2 hours

We obtained and also spectrophotometered complexes of iodine with purified starch and Amylose. Samples of starch and Amylose were dispersed in 1 n NaOH with the addition of iodine as KI. Fifty milligrams of starch and Amylose were dispersed for one hour in 4 millileters of NaOH. The volume was raised to 15 millileters. Five millieters were transferred to 100-millileter flasks for the starch and 200-millileter for the Amylose, neutralized with 0.1 HCl to pH 5, one millileter of Iodine as KI was added (2.5 grams I and 3.75 grams KI in 500 millileters of distilled water).

The data in Table 3 showed that D is, in the case of the control, larger than in the case of the starch and Amylose that was ripe at 140°C. A decrease in D of the collared complex (Amylose--Iodine) indicate that an Amylose spiral is short in comparison with the controlled Amylose.

TABLE 3

Wave Length NM	Starch		Amylose	
	Depending on the Treatment			
	Control	140°C	Control	140°C
600	0,462	0,459	0,632	0,528
605	0,466	0,460	0,650	0,540
610	0,462	0,455	0,655	0,542
615	0,465	0,460	0,658	0,550
620	0,462	0,452	0,660	0,549
630	0,450	0,445	0,659	0,548
640	0,441	0,438	0,650	0,540

CONCLUSION

During the irradiation and drying of grain at 140°C, processes apparently take place therein which are related with a change in the structure of the starch by its degradation; in particular, with a certain degradation of Amylose.

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During the irradiation and drying of grain at 140°C, processes apparently take place therein which are related with a change in the structure of the starch by its degradation; in particular, with a certain degradation of Amylose. In this study, corn containing 13% moisture was irradiated with γ rays from Co^{60} at doses of 10^5 and $1.5 \cdot 10^6$ R. The starch was then extracted from non-irradiated corn as well. The viscosity ratio was calculated, as well as molecular weig ht and degree of polymerization.

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ionizing						
glucoside						
depolymerization						
degradative						
"cross-linking"						
VIR-42 GUB-800						
Pinkevich viscometer						
Gagedorn-Jensen [7]						
alkali lability						
Schoch and Jensen [8]						
Amylose						
"blue number"						
Smirnova-Ikonnikova [9]						
SF-4A spectrophotometer						
weighted mean						

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